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New *Candelariella* records for TurkeyMEHMET GÖKHAN HALICI^{1*}, MUSTAFA KOCAKAYA² & EMRE KILIÇ¹¹Erciyes Üniversitesi, Fen Fakültesi, Biyoloji Bölümü, 38039 Kayseri, Turkey²Bozok Üniversitesi, Fen Edebiyat Fakültesi, Biyoloji Bölümü, 66200 Yozgat, TurkeyCORRESPONDENCE TO *: ¹mghalici@erciyes.edu.tr,²mustafa.kocakaya@bozok.edu.tr, ¹emreklc2910@gmail.com

ABSTRACT — Three species of *Candelariella* — *C. aggregata*, *C. plumbea*, and *C. rosulans* — are reported for the first time from Turkey.

KEY WORDS — *Ascomycota*, lichenized fungi, biodiversity, disjunct distribution

Introduction

Studies to determine biodiversity of lichenized fungi in Turkey have an extremely short history, although John (2004) cited 360 papers listing lichens from the country. In the last ten years, lichenological research has been rather intensive and has yielded numerous new Turkish records (e.g. Güvenç 2002; Öztürk & Güvenç 2003; Breuss & John 2004; John & Breuss 2004; Halıcı et al. 2005; Tufan et al. 2005; Güvenç et al. 2006; John & Türk 2006; Halıcı & Aksoy 2006; Halıcı et al. 2007a; Candan & Türk 2008; Yazıcı et al. 2008; Halıcı & Güvenç 2008; Halıcı & Aksoy 2009; Kocakaya et al. 2009; Kınalıoğlu 2009a; Kınalıoğlu 2009b; Yazıcı et al. 2010; Halıcı et al. 2010). Approximately 1200 lichenized fungi are now known from Turkey but, considering its size and diversity of phytogeographical regions and habitats, at least 2000 species might be present in the country (Halıcı et al. 2007b).

The lichenized fungal genus *Candelariella* includes species with 8- or polyspored asci of the “*Lecanora*”-type, biatorine or lecanorine apothecia, and a secondary chemistry with pulvinic acid and derivatives. Of the approximately 50 species described worldwide (Westberg 2004), only 10 are known in Turkey (e.g. Breuss & John 2004; Candan & Türk 2008; Güvenç et al. 2006; Halıcı & Güvenç 2008; Halıcı & Aksoy 2009). With this report of three new records for Turkey, the number of *Candelariella* species in the country reaches 13. A modern revision of this genus will most likely increase this number.

Material & methods

The specimens are deposited in the lichen herbarium of Erciyes University, Biology Department (Kayseri, Turkey). They were examined by standard microscopic techniques. Hand-cut sections were studied in water, potassium hydroxide (KOH) and Lugol's solution (I). Measurements were made in water. When measuring the ascospores, 50 ascospores from 5 different apothecia were measured; only the ascospores outside the asci were measured. The descriptions summarized below for each species are our descriptions of the Turkish specimens.

Taxonomy

Candelariella aggregata M. Westb.

FIG. 1A–B

ORIGINAL DESCRIPTION — Westberg (2007).

Thallus granular, distinct, yellow, granules scattered and obscured by the aggregated apothecia, K–, C–, Pd–. Apothecia lecanorine, rounded to irregular, in proper margin isodiametric cells of 3–4 μm present. Hymenium hyaline, 60–65 μm ($n = 5$). The algal layer is more or less continuous below the hypothecium. Asci clavate, 8-spored, ascospores simple, hyaline, ellipsoid, 13.5–17 $\times$ 5.5–6.5 μm ($n = 50$).

New record for Turkey. The specimen from Antalya was collected on plant debris with *Caloplaca stillicidiorum*. *Candelariella aggregata* was described from North America on mosses and plant debris, often on *Selaginella* tufts. It is also known from Alaska and northern Canada in arctic-alpine or steppe-like areas (Westberg 2007). Westberg (2007) stated that *C. aggregata* might possibly be a circumpolar species, although at the time it was known only from North America. The species has since been reported from Europe (Urbanavichus & Urbanavichene 2008, Spinelli 2011, Westberg & Clerc 2012), collected in alpine habitats in Romania (CBFS JV3754), included in the Russian checklist (Urbanavichus 2010), and from Asia (Westberg & Sohrabi 2012).

MATERIAL EXAMINED: TURKEY, ANTALYA, Alanya, Gevne valley, Şeker Pınarı Position, calcareous rocks in *Pinus nigra* forest, 36°45'19"N 32°27'69"E, alt. 1350 m, 25.09.2009, M.G. Halici & M. Kocakaya (MGH 7850); VAN, Lake Van, SW of Bayramlı, limestone rocky outcrops near coast, 38°56'38"N 43°09'05"E, alt. 1680 m, 11.05.2007, J. Vondrák (CBFS JV8579).

Candelariella plumbea Poelt & Vězda

FIG. 1C–D

ORIGINAL DESCRIPTION — Poelt & Vězda (1976).

Thallus grayish, but sometimes partly yellow pigmented, granulate to squamulose, very well-developed. Isidia-like protuberances present. Apothecia 0.2–0.5 mm ($n = 5$), with a yellowish to grey apothecial margin. Hymenium 65–70 μm high ($n = 5$). Asci 8-spored. Ascospores straight to slightly curved, 13.5–16(–18.5) $\times$ 6–9 μm ($n = 50$).

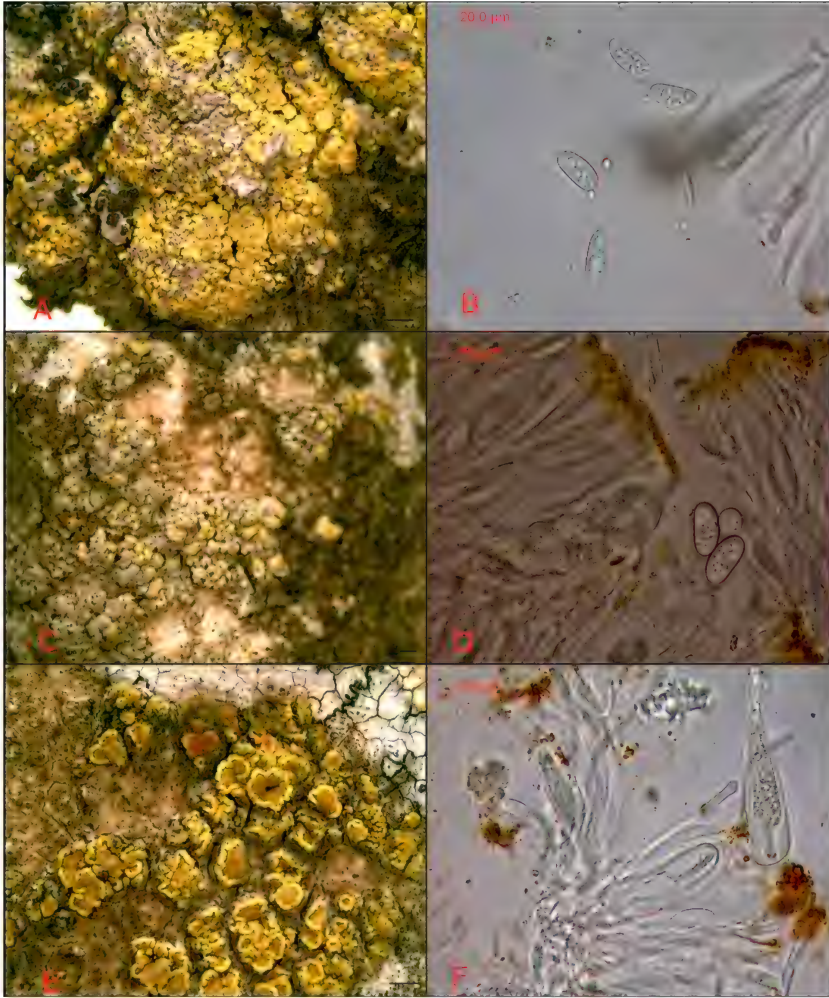


FIG. 1. *Candelariella aggregata*: A, Thallus; B, Ascospores. *C. plumbea*: C, Thallus; D, Ascospores. *C. rosulans*: E, Thallus; F, Paraphyses, asci and ascospores. Scale bars: A, C, E = 3 mm.

New record for Turkey. Both specimens, collected from dolomite rocks in the southern part of Turkey, are obviously lichenicolous on *Staurothele areolata*, at least in the young stage of their development.

Candelariella plumbea was described from lowlands at about 50 m altitude in Romania (Poelt & Vězda 1976). According to Nimis (2003), this species is an arctic-alpine lichen. Vondrák et al. (2008) stated that specimens growing in alpine habitats have a less conspicuous thallus resembling *C. aurella* and are

possibly not conspecific with the xerothermic populations; our alpine collections from Turkey have rather well developed thalli. Ascospore measurements of the Turkish specimens differ from the measurements given in original description ($14\text{--}18(-20) \times 4.5\text{--}6\text{ }\mu\text{m}$; Poelt & Vězda 1976), especially the spore width. Inconsistencies in ecology and morphology of various *C. plumbea* populations cannot be reasonably interpreted here.

Candelariella plumbea has previously been reported from Romania, Austria (Poelt & Vězda 1976), Bulgaria (Vondrák 2006), Italy (Nimis 2003), Greece (Spribille et al. 2006; Vondrák et al. 2008), Hungary (Vondrák et al. 2009) and Ukraine (Khodosovtsev 2005). It has also been reported from Colorado in North America (Weber 1990).

MATERIALS EXAMINED: TURKEY. İÇEL, Çamlıyayla, Bolkar Mountain, Meydan plateau, calcareous and siliceous rocks, step vegetation, $37^{\circ}24'5''\text{N}$ $34^{\circ}33'55''\text{E}$, alt. 2340 m, 23.09.2011, M.G. Halıcı & E. Kılıç (MGH 7851); KAYSERİ, Yahyalı, Aladağlar National Park, Gököluk position $37^{\circ}55'84''\text{N}$ $35^{\circ}17'42''\text{E}$, alt. 2340m, 11.07.2006, M.G. Halıcı & M. Kocakaya (MGH 2294); KIRKLARELİ, Vize, Kıyıköy, North of the village, coastal rocks, $41^{\circ}40'\text{N}$ $28^{\circ}05'\text{E}$, alt. 2-5 m, 08.07.2005, J. Vondrák (CBFS JV3077).

Candelariella rosulans (Müll. Arg.) Zahlbr.

FIG. 1E–F

ORIGINAL DESCRIPTION — provided by Westberg (2007).

Thallus squamulose, lobes $1\text{--}1.5\text{ }\mu\text{m}$, forming small rosettes; orange-yellow, K+ reddish. Apothecia common, lecanorine, thalline margin persistent, thick, crenulate, proper margin indistinct. Epihymenium yellow brown. Hymenium hyaline $60\text{--}90\text{ }\mu\text{m}$ ($n = 5$), subhymenial layers colorless, with oil droplets. Asci clavate, 8-spored, ascospores colorless, simple, not very well developed, $14\text{--}16 \times 5\text{--}7\text{ }\mu\text{m}$ ($n = 10$).

New record for Turkey. The specimen was collected on calcareous rocks with *Caloplaca* spp., *Rinodina immersa*, and *Verrucaria nigrescens* in a shaded habitat. *Candelariella rosulans* is widely distributed in western North America (although not common on calcareous rocks; Westberg 2007) and has recently been found in Iran (Westberg & Sohrabi 2012). *Candelariella oleifera* H. Magn. from Central Asia is possibly synonymous (Westberg & Sohrabi 2012). Khodosovtsev (2005) described *C. rosulans* from southern Ukraine material; most characters fit well with *C. rosulans*, except that the Ukrainian ascospores are larger.

MATERIAL EXAMINED: TURKEY. İÇEL, Çamlıyayla, Ardıçlı village, *Pinus brutia* forest, $37^{\circ}12'51''\text{N}$ $34^{\circ}46'10''\text{E}$, alt. 960m, 23.09.2011, M.G. Halıcı & E. Kılıç (MGH 7852).

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